Glencoe Cotton Mill, 1880-1954
Junction of State Route 1598 and State Route 1600
Alamance County
North Carolina

HAER NC-6

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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HISTORIC AMERICAN ENGINEERING RECORD

Glencoe Cotton Mills

NC-6

Location:	Junction of State Route 1598 and State Route 1600, Alamance County, North Carolina.
Date of construction:	1880-1954
Present owner:	Myron Rhyne, 211 E. Parker St., Graham, NC.
Significance:	Glencoe developed at the time when the shift from water to steam power was seriously considered by cotton mill builders in Alamance County. Glencoe's existent mill houses, original mill buildings, and 1880-1894 water-powered machinery, make it one of the best preserved cotton mill villages in Alamance County. Although no early textile machinery remains, the village presents important evidence relating to the earliest forms and development of the textile industry in the county.
Historian:	Brent D. Glass, 1977.

INTRODUCTION:

On January 26, 1878 the various partners in E. M. Hold & Sons purchased the Company mill tract along the Haw River in Alamance County, North Carolina. With plans to use the mill tract's water rights to power an additional Holt family cotton mill, Holt paid Joseph S. and Levi A. Vincent $8,000 for the 38.9 acre property. [1] A grist and saw mill occupied the site from the early 1860s. [2] The Vincents also may have operated a tobacco processing plant on the site and they apparently anticipated enlarging their operation; the property sale included "the building material for a factory house, including brick, lumber, lime, stone, derrick, shingles and other material." [3]

The Holt's development of the Glencoe Cotton Mills and the village on the Company mill tract futhered Alamance County's industrial development where, since the 1830s, cotton mills, relying on the county's abundant water power drew workers from and supplemented local agriculture. In 1837 Edwin Michael Holt built the Alamance Factory at the site of his father's grist mill on Great Alamance Creek. From this start, through the early twentieth century, the Holts dominated the local cotton and textile business and opened several other factories throughout the county. [4]

James H. and William E. Holt, Edwin M. Holt's sons, were largely responsible for establishing the Glencoe Cotton Mills and the surrounding village. Built between 1880 and 1882, Glencoe developed at the time when the shift from water to steam power was seriously considered by cotton mill builders in Alamance County. Along with Altamaha and Ossipee mills also established in 1882, Glencoe was the last of the county's cotton mills to be developed primarily for water power. The Aurora, Oneida, and Plaid Mills, established in 1881, 1882, and 1883 respectively, were the first in the county to be powered by steam. [5] Even though steam and water powered the same mill operations, the two sources fostered and used distinct social, technical, and physical environments. As long as the mills depended on water power, the mill-operators found it necessary in nearly all cases to develop their plants on isolated sites along the Haw River and its tributaries. Since the power available from the Haw River was not sufficient to support a group of mills on any single site, mill-operators had to build entire villates to attract, house, and support the mill workers and their families. These villages developed along traditional paternalistic lines.

Glencoe's existent mill houses, original mill buildings, and 1880-1894 water powered machinery make it one of the best preserved cotton mill villages in Alamance County. Although no early textile machinery remains, the village presents important evidence relating to the earliest forms and development of the textile industry in the county.

With the adoption of steam power, manufacturers gained more freedom in locating their plants and many adopted sites in previously existing towns, especially those located along the North Carolina Railroad. [7] In these

towns the manufacturer's freight costs were greatly reduced since it was no longer necessary to haul material from the railroad station to the mill, six ro seven miles away. Cotton mill owners provided limited housing in these towns. The commercial, religious, and educational functions of the mill villages were gradually absorbed by the older towns' structure. Combined with diverse industrial and commercial operations, the distrinctiveness and predominance of the cotton mill village and industry, represented by Glencoe, subsided.

THE MILL IN 1880: BUILDINGS

In 1879 as part of their plans to build a mill for manufacturing plaid, checked, and striped cloth and a village on the Company mill tract, James H. and William E. Holt purchased an additional 148.2 acres of land. [8] The original cotton mill did not incorporate any of the grist mill or saw mill buildings into its operation. The five major buildings in the mill were constructed of brick and wood beam. They included the main three story Mill Building, 200' x 50'; the one story Dye House, 145' x 30'; the one story Picker House, 60' x 33'; a one story Cotton House, 24' x 48'; and a two story Warehouse, 60' x 26'. The possibility of fire seems to have determined placing the mill, the picker, and the dye operations in separate buildings. This was particularly true of the Picker House where the bales were first opened, mixed, and run through lappers. Foreign materials mixed in with the cotton and the loose fiber into which the cotton was first worked made the Picker House particularly fire prone and the most dangerous part of the plant. [9]

The approaches to the building helped determine the placement of architectural ornamentation on the Mill Building. The stucco window moldings appear on the front and sides of the building and not on the rear. The north cornise received more architectural embellishment than the south because the main approach to the building was over a bridge at the north end of the mill site. In 1904 the bridge was relocated at the site's south end.

Water Power:

In adapting the water right to power the entire mill, the Holts apparently extended and deepened the mill race to approximately 600 yards. Except for the areas around the water gates and the wheel house, the race did not receive any structural reinforcement. It was a ditch which channeled water from the Haw River to the wheel house, and out along the tail race back to the river. Half way along the west bank of the head race a set of gates could be opened to dump water into a spillway running directly to the river without passing through the mill; this spillway and gate are no longer in place. A second spillway with a manually operated gate could channel water from the front of the head race's trash rack directly into the tail race. Water could also flow through a manually operated gate in the wheel house before passing through the water turbine.

The mill continued to use the log and stone dam which backed up water for the grist mill's pond. The dam was approximately 250' long and 8' high, giving a fall of 13.5'. [10] The Holts expected to draw 152 horsepower from the fall. George F. Swain, a hydraulic engineer who studied the site in 1881, wrote "according to my estimated I doubt if this can be done unless the pond is large." [11] The original water-power system furnished a maximum of 130 hp to the Holt

plant. [12]

In 1881 the Holts purchased a James Leffel Patent Double Trubine water wheel from Poole & Hunt Company of Blatimore, Maryland. The Holts paid $1,896.42 for the 66" #2 water wheel, the vertical and horizontal shafts, the gearing and the pedestals. In 1873 the Holt & Moore cotton mill in Haw River operated a Poole & Hunt 66" #2 wheel which may well have determined their decision to install the same wheel at Glencoe. [13] Operating under a head of approximately 12', the 66" turbine was expected to consume 7,500 cubic feet of water per minute and furnish 152 hp. The horsepower actually generated was somewhat less than anticipated, probably caused by problems with the race or wheel house. The turbine's up, or vertical shaft, was 5.7" x 11' 9". [14] The turbine turned the line shaft at 113.5 revolutions per minute. [15] An A. N. Upham Governor controlled the water wheel speed.

Located on the north side of the main Mill Building, the water wheel drove a horizontal line shaft which enetered the Mill at the floor level on the first floor and ended just inside the wall. The shaft was coupled to a pulley 107" in diameter with a 26" face. A series of belts and pulleys drove the line sahfts running along the ceiling of the first, second, and third floors. The original mill machinery account for the mill indicates $1,367.54 was paid for shafting to Thomas Wood & Son of Philadelphia, and $947.07 paid to J. B. Hoyt & CO. for belts. A 3' section of the main line shaft connected with an original pulley remains in place on the first floor of the Mill Building (1977).

Machinery and Layout:

The layout of the cotton working operations at Glencoe was apparently during the first 50 or 60 years of operation. In the Picker House saw cotton was taken from bales mixed on the floor and fed through the opener machine where the cotton was beaten and broken into loose fiber; suction moved the fiber through a flue to the breaker lapper. The breaker lapper beat and drew the cotton further and rolled it into laps three to four feet wide. The laps were worked and drawn again in the intermediate and finisher lapper. The lappers reduced the amount of dust in the cotton and distributed the weight of the cotton evenly throughout the lap. At Glencoe, raw cotton was dyed in the Dye House and then moved to the Picker House for processing into laps.

The laps were then moved to the third floor of the Mill Building by an elevator located in the northwest corner of the building. The second and third floors housed operations almost exclusively devoted to making the cotton fibers parallel and drawing and twisting them into yards. The yarn was then spooled and placed on spindles and warps ready to be moved to the first floor and loaded onto the looms where the cloth was actually woven. The various finishing operations were originally carried out on the third floor before being moved in 1903-1904 into a separate building. The general machinery layout at Glencoe included carding machines, drawing, slubbing, and roving frames and ball warping on the third floor; spinning, spooling, and creeling the second; and weaving on the first. [16]

When Edwin M. Holt started Alamance County's first major cotton mill in 1837 he traveled to Patterson, New Jersey to purchase the necessary machinery. In 1880, Holt's sons also turned to established textile machinery manufacturers in the North to outfit their mill. The 186 looms operating at Glencoe during the 1880s and 1890s were purchased from Thomas Wood & Son of Philadelphia for $6,909,20. [17]

The Lowell Machine Shops in Lowell, Massachusetts, furnished most, if not all, the original spinning machinery installed at Glencoe. The mill operated at least nine Lowell Spining Frames with 28 stands and 208 Sawyer medium gravity spindles. [18] The Lowell Machine Shops' original bill to Glencoe was for $8,010.19 and may have included drawing, slubbing, and roving frames. J. & J. Murdock furnished the original carding machines for $922.50. [19] Etlinger & Edmund Company built the boiler and stack which provided the steam for dyeing and drying cotton in the Dye House. [20]

The dye operations occupied north end of the Dye House and the dry room was located in the south end. These two sections were separated by a room for "drugs," various dyes used to color the raw cotton. The distance from the Dye House to the main mill and the water wheel meant no water power could be used to operate machinery in the Dye House. A $405.00 bill for an engine from Etlinger & Edmund makes it appear likely that a small steam engine powered machinery in the original Dye House as it did after 1900. [21]

Glencoe Village and Business:

Glencoe's villate and mill housing expanded with the mill. The Holts owned the land and housing rented to wrokers. Although no record of the building activity in the village exists, the majority of the housing, the church, and the company store-office building appear to date from the 1880s and 1890s. The single family housing consists of one and two story detached, wood-frame, houses with three and five 16 x 16 rooms respectively. The houses occupied both sides of two roads extending up the hill to the east of the mill. Wells located between the houses provided water. Some of the houses had outside kitchens and all had outhouse toilets. Insurance records for 1907 include insurance for 41 workers' houses; respresenting the majority of the 48 houses built in the village.

When Glencoe began operation in 1881 its 3,120 spindles and 186 looms produced plaid, checked, and striped cotton cloth. Throughout its operation Clencoe relied on direct selling sales agents, and wholesalers, located primarily in New York City. The sales agents included Cone Export Company, Clark & Champion, Wm. Iselin, Marshall Field Warehouse Company and J. W. Valentine. For a time various Holt owned mills in Alamance County also maintained a central sales agent in New York who distributed their cloth but this marketing has short lived. The rapid disappearance of Holt textile plants after 1930 can, in part, be attributed to the family's failure to consolidate and coordinate their operations into a single corporation.

The Glencoe Mills' response to a 1890 North Carolina Bureau of Labor Statistics questionaire offers a glimpse of the industrial and labor conditions in Glencoe. [22] During the previous year 3,120 spindles and 186 looms were in operation and the mill employed an average of 40 men, 57 women, 20 boys, and 16 girls. The mill operated a total of 292 days, 11 hours per day, 6 days per week. The average daily pay was $2.00 for skilled, and $1.00 for unskilled, men; $1.00 for skilled and $ .50 for unskilled women; and $ .40 for children. "Most" of the workers lived in company owned houses for which they paid "a very low rent." Nine employees were reported to live in their own houses, presumably not in Glencoe. Although living in company housing and trading at the company store was not required, little other shopping or housing existed in the area.

It is unlikely that the Holts ever profited economically from renting the mill houses. Between 1904 and 1920 the "very low rent" reported in 1890 was $1.40 a month for a three room house and $2.00 for a five room house. A 1920 survey of housing by employers in 48 Southern cotton mill villages found that only 9.3 percent of the five room houses and 33.4 percent of the three room houses rented for under $3.00. [23] The same survey indicated some of the employers' advantages associated with mill housing which undoubtedly played a part at Glencoe over and above providing necessary housing for the mill workers where none had previously existed. The housing helped insure a stable supply of labor by typing entire families to the mill. The mill village housing, if rented inexpensively, fostered loyalty to the company as well as a degree of control. An employee who upset the company stood to loose not only his job but also his home. The mill village also permitted a more flexible work schedule to match irregular production schedules and news of production cutbacks or shutdowns could be easily circulated to employees. [24] The family housing at Glencoe also permitted the mill to draw men, women, and children to work in the mill from the families residing in the village. Glencoe payroll books indicate that several people with the same family name worked in the mill. If an unskilled husband and wife and one child worked in the mill during full operation in 1890 they would early $11.40 a week and pay $ .50 rent for their house. In 1890 an average of five occupants resided in each house and this may have included some families who took in mill workers as boarders.

Receiving materials from a number of wholesalers, primarily local, the Glencoe company store sold a wide variety of dry goods, clothing, food, tobacco, and coal for heating and cooking. The store account book reveals a diversity of goods ordered and it appears that goods not in stock could generally be ordered.

48" Cylinder Gate Victor Turbine: 1894:

From the 1880s until after 1900 the Glencoe's operation in terms of product, size of plant, number of employees, mode of power, machinery, and production remained fairly constant. In 1894, apparently dissatisfied with

the horsepower generated by the Poole & Hunt 66" turbine, Glencoe installed a new turbine. Robert Poole & Son Company, the successor firm of Poole & Hunt, offered to install a 66" Special Water Wheel providing 23% more power under the same head for $875.00. The Holts declined the offer and ordered a 48" Cylinder Gate Victor Turbine from the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio. The new turbine was installed in September, 1894, in the old wheel house without altering the size or arrangement of the flume remains in place today (1977). A new vertical shaft, 13' 6", replaced the old shaft and connected to a horizontal line shaft through a set of bevel gearing, a horizontal mortise wheel, and a vertical pinion wheel. The mortise gear, 62.40" in diameter, and the pinion gear, 46.84" in diameter, replaced the older gears in order to more efficiently transmit the increased horsepower between the turbine and the line shaft. The old Poole & Hunt gear frames housed the new gears. [25]

The Victor turbine received water from the outside of the chute case and discharged it downward and outward into the 8' deep lower chamber of the wheel house. For smooth operation of the mill's belt driven machinery the water turbine must maintain a fairly constant speed even under the variable volumes of water reaching the wheel house. The column of water above the turbine was approximately 12' high. The most important means of regulating the speed is by regulating the amount of water reaching the turbine buckets. In the Victor turbines the gates inside the chute case control the amount of water reaching the water buckets. In the cylinder gate models a cylinder, closely fitting the inside of the chute case, is raised and lowered from the dome at the top of the turbine. The position of this cylinder over the chute case openings admits or restricts the flow of water into the water wheel buckets and thus regulates the speed.

Type O Lombard Governor:

A water wheel governor monitors and regulates the speed of the water wheel through a set of gears controlling the position of the water wheel gates. In 1904 the Lombard Governor Company of Boston and Ashland, Massachusetts, proposed to connect Glencoe's 48" turbine with the Type O Governor "giving you more accurate speed regulation than any of the other makes of governor on the market." The Lombard Type O governor did not actually replace the earlier governor until 1913 and is still in place at Glencoe (1977). The Lombard governor is an oil type governor consisting of a piston connected through gearing with the shaft controlling the movement of the cylinder gate. The piston moves by oil supplied from a reservoir under 200 pounds air pressure per square inch. The governor balls control the valve admitting and draining oil from the cylinder. One complete stroke of the governor piston raises or lowers the cylinder gate completely.

The cylindrical tank under the governor cylinder is divided into an oil reservoir and a vacuum chamber. A governor pump, powered by a belt and pulley directly to the turbine's horizontal shaft, supplies the 200 pounds

air pressure for the oil reservoir as well as maintaining the vacuum in the vacuum chamber. The movement of the governor piston and the water wheel cylinder gate takes place when oil from the pressure reservoir is admitted to one side of the piston and oil from the other side is drawn off through the vacuum and returned by way of an intermediate reservoir to the pressure reservoir. The piston is activated when the load on the governor balls changes. A pulley and belt connected to the turbine's horizontal shaft drives the governor balls. As the speed of the shaft increases or decreases, the governor balls move further from or drop closer to the axis of rotation. As the balls spread out they depress the top plate into which their supporting flat springs are inserted. The top plate in turn is connected to a rod which passes to a small vertical piston valve. As the balls spread apart under increased speed they depress the psiton valve and they contract when the speed falls below normal the rod and valve is lifted. At a normal speed the rod closes the piston valve; as the speed increases or decreases, the rod id depressed or lifted, then oil is admitted to one side of the piston or the other. The piston movement is transmitted through the gearing connected to the water wheel and raises or lowers the cylinder gate. A large hand wheel on the governor permits manual adjustment of the piston, the gates, and thus the speed of the turbine. [26]

18" Cylinder Gate Victor Turbine: Electric Light at Glencoe:

On October 13, 1894, shortly after Glencoe put its 48" Victor turbine into operation, the Holts ordered an 18" Cylinder Gate Victor Turbine to generate power for electric lights in the Mill. The turbine was ordered after spirited bargaining between Glencoe and Stilwell-Bierce & Smith-Vaile Company. At one point in the negotiations over the price, Stilwell declined a Glencoe order writing, "We want orders badly, and we are willing to accept them at a very close margin of profit but your offer would wipe out that margin Entirely, hence we are obliged to decline it. We do not pretend to meet the competition in prices offered by some water wheel builders neither does their work meet our quality. There are water wheels, and water wheels." [27] Glencoe finally paid $500.00 for the wheel.

The 18" turbine, no longer in place, was installed in November, 1894 in the same wheel house that held the 48" turbine. [28] Under a head of approximately 12' the turbine turned the 13' 6" x 3' 3/16" vertical shaft at 242 revolutions per minute. A bevel mortise and pinion gear transmitted the vertical shaft rotation to a horizontal shaft and increased its peed to 484 revolutions per minute. The horizontal shaft terminated with a pulley which turned a belt connected to a lighting dynamo or electric generator. [29]

Glencoe was one of Alamance County's first cotton mills to install electric lights and on December 20, 1894 the Alamance Gleaner reported: "A splendid electric light system has been put in Glencoe Cotton Mills." [30] The lighting dynamo was housed in a small room just to the north of the Wheel House, between the Mill and the Picker House, where the fire pump equipment is housed today (1977). Speed regulation in the lighting turbine was not as important as regulating the turbine driving the machinery, and the 18" turbine governor may have been little more than a manually operated gear raising and lowering the cylinder gates. [31] The 18" Victor turbine apparently generated elec-

tricity for lighting the mill until the 1930s when outside utility electric power was purchased. In 1905 the pwoer generated from the two turbines was reported at 190 horsepower.

Glencoe Around 1900: Products:

Around 1900 Glencoe began manufacturing different styles of cloth, modernized old machinery, and purchased new machinery. They also produced outings and began napping their fancy cotton goods. After weaving the cloth ran through napping machines where bristles and wire brushes made some of the woven fibers project outward giving the cotton cloth a textured appearance similar to wool. The napped cloth was used extensively in outings, such as night gowns and blankets.

Napped Cloth: Machinery and Buildings:

Glencoe manufactured limited amounts of napped cloth during the late 1890s using machinery manufactured by the American Napping Machinery Company and in 1897 they considered purchasing nappers from the Woonsocket Napping Machinery Company. [32] Apparently they did not add any napping machinery until the mill began napping a sufficient quantity of its cloth around 1900. In 1902 Glencoe purchased the first 72",]4 roller, Eclipse napping machine to be manufactured by Richard C. Borchers & Company, of Philadelphia, Pennsylvania for $1,250.00. An identical machine was purchased in 1909 and in 1904 Borchers sold Glencoe a 72", 14 roller, Eclipse napping machine fro $1,000.00. [33] Glencoe also operated a 72" Heap French Napper. In 1903, a 72" x 12" Ray Traverse Grinder was purchased for cloth finishing. [34]

During the 1890s Clencoe probably ran its limited napping cloth operations in the cloth room on the third floor of the Mill Building. The increased production of napped cloth necessitated the construction of additional space to accommodate the new napping machinery. In September, 1903, Glencoe hired O. A. Robbins & Co., Architects and Mill Engineers, from Charlotte, North Carolina, to design a Finishing and Napper Room. [35] The limitations on space adjacent to the Mill Building and the limited horsepower available from the existing water turbine contributed to the decision to build the Finishing and Napper Room adjacent to the Dye House since a boiler and steam engine could power both the Dye House, the Finishing, and Napper Room machinery.

Robbins designed the one story brick and wood beam building, 100' x 43', and advised Glencoe to install a 40 hp steam engine to drive the machinery and a 120/125 volt General Electric generator fro lighting. [36] Glencoe purchased $510.00 Brownell Self-Contained Automatic Steam Engine for this purpose. The engine was a standard side crank type with overhanging cylinder, 9" in diameter and had a 16" stroke. With 80 pounds of steam boiler pressure running at 250 revolutions per minute, the engine produced 57 horsepower. The governor was a Rites patent inertia shaft type and the bank fly wheel was 48" in diameter with a 12.5" face which weighed about 1,600 pounds. [37] The

Brownell engine may well have replaced a 10 x 10 vertical steam engine manufactured by Nagle Engine & Boiler works, Erie, Pennsylvania which was not sufficient to power the new machinery.

In December, 1905, Glencoe hired Ludwig & Co., of Atlanta, Georgia, to determine the power used in the Dye House and the Finishing and Napper Room. Ludwig found the Finishing and Napper Room utilized 20.8 hp; the Dye House 10.83 hp; the Dynamo 3.65 hp; and 20.5 hp was lost to the total friction load in the engine and shafting. The total power from the engine was 55.78 hp. Ludwig agreed to study additional water, electric, or otherpower sources and in the mean time suggested inspecting the shafts and pulleys for signs of wear and increasing the steam power. Ludwig also pointed out that the friction load for larger engines would constitute a lower percent of the total power. [38] The power study may have influenced Flencoe's decision to install a larger steam engine because in November, 1906, they purchased a Hamilton-Corliss Horizontal Non-Condensing Engine from the Hoover, Owens, Rentschler Co., of Hamilton, Ohio. The cylinder was 12" in diameter and had a 30" stroke. With 100 pounds of steam pressure and running at 90 revolutions per minute, the engine produced 83 hp. The band fly wheel was 9' in diameter with a 15" face and weighed about 5,700 pounds. [39]

No machinery remains intact in the Dye House and Finishing and Napper Room engine room, and no evidence reamins as to whether the Hamilton-Corliss engine supplemented or replaced the Brownell engine. In 1913 a new horizontal tubular boiler replaced the old boiler at the Dye House. Only parts of the boiler remain. Most of its has been sold off for scrap and the smoke stack has been removed.

Dye House:

Steam engines ran a variety of dyeing and drying machinery in the 1880 Dye House. In the late 1890s Glencoe added several hydro extractors, centrifugal drying machines which dried the cotton after it was removed from the dyeing machines. One of the extractors was a 44" copper basket extractor manufactured by the Tolhurst Machine Works, of Troy, New York. The Tolhurst extractor was powered by a 5 hp vertical engine manufactured by Troy. Glencoe sold the Tolhurst extractor in 1918 to make room for larger drying machines. [40]

H. W. Butterworth Co. drying machines also operated in the Dye House in the early 1900s. Once machine was a 42" x 23" nine cylinder type and a second machine was a Butterworth eight warp dryer. [41] In the early 1900s a Klauder-Weldon Dyeing Machine Co. 1,000 pound capacity machine operated in the Dye House as well as a stock dyeing machine purchased in 1897. [42]

Steam from the Dye House horizontal tubular boiler was used in the cotton dyeing operations. The steam also powered a Moore Steam Turbine Corporation Centrifugal Pump which pumped water from the mill race into the Dye House for use in dyeing. When the plant began using electric power a General Electric Textile Mill Motor was installed to drive the pump. Both the pump and the motor remain intact in the small pump house located northwest of the Dye House.

The Dye House production book for 1902-1910 shows the Dye House generally opened from one to three bales per day, or six to ten bales per week. Six thousand to ten thousand pounds of cotton were dyed every week of operation.

New Machinery in the Mill Building:

At the same time the machinery and structures in the Dye House and Finishing and Napper Room were being altered and installed, much of the machinery in the main mill was modernized, replaced, and supplemented with new machines. Around 1900 the number of spindles operated in the mill rose from 3,120 to 4,000, and by 1907 the number rose to 5,000 ring spindles. The new spindles were purchased primarily from the Whitin Machine Works of Whitinsville, Massachusetts. Glencoe installed some Whitin spinning frames in 1898 and then in three separate orders in 1900, 1904, and 1905 eleven more frames were added. Each spinning frame carried 208 Medium Whitin Gravity Spindles, with 2.75" between spindles and a 1.5" ring. By 1905 the Whitin frames held nearly half of Glencoe's spindles. [43]

In 1903, undertaking a major mill modernization, Glencoe purchased over $11,000.00 worth of new textile equipment from the Howard & Bullough American Machine Company (H & B) of Pawtucket, Rhode Island. The new equipment nearly replaced all the machinery on the third floor of the Mill Building. Twelve new revolving lfat cards replaced all the old carding machinery. The new cards received 40" wide laps from the Picker House and delivered sliver strands into 36" x 12" cans. Around 1915 three more H & B cards were installed at Glencoe. After carding, the cotton fibers were approximately parallel but are still entangled with one another. From the cards the sliver is placed on a drawing frame where some of the curl is stretched further and the fibers are mademore parallel.

Glencoe's order from H & B included two new drawing frames. Each frame had two heads; each head drew sliver from 6 sliver cans and delivered the combined sliver into a single can. Thus the two frames could draw on 24 deliveries at one time. After the drawing frames the cotton sliver is further drawn, twisted, and wound on bobins on the slubbing, intermediate roving, and roving frames. The 1903 machinery additions included two slubbing frames with 56 spindles each, one intermediate frame with 96 spindles, and four roving frames with 136 spindles each. [44]

When Glencoe ordered machinery from H & B the manufacturer dispatched experienced fitters at $4.00 a day to supervise the installation. The installation of such a large number of new machines required a complete alteration of the Mill's power transmission and shafting arrangement. The Engineering Department of H & B provided complete engineering drawings and designs for the layout of the new machinery. The new shafting and pulley arrangement incorporated some sections of the old main and counter shafting

as well as some of the old pulleys. Alternative plans were outlined with their expected impact on the performance of the machinery. The Engineering Department wrote: "In place of new Counter No. 2 you could use old counter 1 5/16" diameter with old Pulleys 22" x 6" for driving slubbers, and old 24" x 3" Pulley on counter instead of 30" x 4". This would speed up the Slubbers to 646 R.P.M. of spindles but they would undoubtedly stand it and with the slip of belts would come down perhaps 5% less." [45]

The engineering assistance provided by H & B conformed to the general pattern of other textile machinery manufacturers dealing with Glencoe. Fitters and erectors almost always helped install the machinery to meet Glencoe's specific requirements and needs. After Glencoe purchased the new machinery its production climbed. Between 1904 and 1910 the weekly production varried greatly with between 10 and 30 bales opened weekly. The Mill spun between 5,000 and 12,000 pounds of yarn each week. [46]

In 1905 and 1907 Glencoe replaced nearly all of its 186 Thomas Wood & Sons looms. In 1905, 100 Crompton-Thayer Loom Company looms were installed. In 1907, 40 Stafford Automatic Looms were installed. The total number of looms, however, operated at Glencoe remained about 200. [47] Using nearly all of the yarn produced in the Spinning Room, the Weave Romm made between 700 and 1,000 cuts of cloth per week; each cut was between 40 and 60 yards long. In 1907 Glencoe apparently considered expanding its weaving operation and paid a mill architect and engineer, R. C. Biberstein, $400.00 to design a weaving annex accommodating 300 looms. [48] Nothing came of these plans and Glencoe continued to operate about 200 looms until the 1930s.

Picker House:

In the early 1900s the Picker House at Glencoe received substantial additions and changes to its machinery. The twelve carding machines purchased in 1903 from Howard & Bullough American Machine Company (H & B) could receive laps up to 40" in width; when Glencoe replaced its old openers and lappers the size of the machines was adjusted upward to produce 40" laps. The large machinery order given H & B in 1903 included a 40" finisher lapper which could accommodate four laps delivered from the intermediate lapper. A 40" intermediate lapper manufactured by H & B also operated in the Picker House. In 1907, adopting more 40" lapper equipment, Glencoe sold for $250.00 a 36" Atherton Finisher Lapper manufactured by Lowell Machine Shops around 1900. The opener machine which first receives the baled cotton and separates it into loose fiber delivers the fiber through a suction flue to the breaker lapper. In 1907 Glencoe replaced these first two production machines with a $1,650.00 Self Feeding Opener with a 30" cylinder, and a 40" Single Beater Breaker Lapper manufactured by H & B. The new opener and breaker replaced an 1890s Atherton Brownell Feed Opener, and a 36" two Beater Breaker Lapper.

Glencoe's water turbine provided power for the Picker House machinery. The Picker House's shafting and pulley drew power from and was coupled to

one of the ceiling line shafts on the first floor of the Mill Building. The overhead line shafts went through the brick wall of the Mill, ran outside, and entered the Picker Room near the ceiling. [49]

Dam and Wheel House:

In 1905 the Chicago Bridge and Iron Works built a 30,000 gallon tank and tower across the road from the Mill. The tank supplemented the 10,000 gallon water tank on the tower of the Mill Building. Both towers held water for the Grinnell Automatic Sprinklers in the main mill buildings. The towers received water from a Fales & Jenks No. 5 Pump with a 500 gallon per minute capacity. The pump intake was in the wheel pit.

In 1909 a wooden dam on a cement foundation replaced the original log and stone dam across the Haw River above the mill. The new dam apparently did not furnish substantial increase in water power and continued to provide the same water fall and mill pond level as the earlier dam. Around 1910 a new masonry, wood beam, and cement wheel house replaced the original wood structure. It is likely the new structure prevented a loss of water and power caused by deterioration of the old wood. The height and volume of the column of water loss from the wheel house, through leaky walls, decreased the turbine's power.

Production and Labor: 1905:

The installation of new machinery, increased production, and the move toward extensive cloth finishing and napping neither drastically affected the number of employees at Glencoe nor stimulated significant additions to village housing. From the 1890s to the 1930s Glencoe employed between 110 and 150 workers, except during World War II when under conditions of increased wartime production, employment reach 200. [50]

A 1905 Census of Manufacturers provides detailed information on the Glencoe operation. Total capital was $145,997.45, including $6,020.00 for land; $39,365.36 for buildings; and $63,793.73 for machinery. In 1904 2,040,353 yards of napped fabrics weighing 491,869 pounds valued at $122,421.18 were produced at Glencoe. The raw materials used included 1,129 bales of cotton weighing 531,013 pounds costing $64,681.84. The Dye House produced 387,750 pounds of dyed cotton. The average "number" yarn spun was 18, meaning 15,120 yards weighed one pound. The coarsest yarn was number 12, or 10,080 yards per pound, and the finest was number 22, or 18,480 yards per pound. Clengoe produced 319,900 pounds of yarn number 20 and less than 171,969 pounds of yarn number 21 and 22.

The 1905 Census reported on saloried officer was paid $1,000.00 a year and three mill superintendents earned a combined income of $1,700.00. There were 111 other employees working 10.5 hours per day of 63 hours per week. There were 51 male and 18 female weavers; 15 males and 17 females, and 10 children worked at spinning and other jobs. Females earned from $ .60 to $.00 per day, and males earned from $ .75 to $2.75 per day. Children received $ .40 per day. Since workers were paid on a piece work basis and overall

production changed from week to week, wages varied. The average weekly wage reported in 1905 is as follows: the ten children earned under $3.00; 13 men (M) and 17 women (W) earned $3.00 to $4.00; 15 M and 6 W earned $4.00 - $5.00; 6 M and 11 W earned %5.00 - $6.00; 12 M and 1 W earned $6.00 - $7.00; 5 M earned $7.00 - $8.00; 10 M earned $8.00 - $9.00; 2 M earned $9.00 - $10.00; 1 M earned $10.00 - $12.00; and 2 M earned $12.00 - $15.00. In 1905 it was estimated that 500 persons were directly dependent upon Glencoe. Some of these lived outside the village. [52]

Between 1905 and 1920 the production at Glencoe and the size of the work force did not increase significantly. Around 1915 Glencoe added cotton flannels to its production of napped goods and outings. In 1927 the mill operated 4,576 spindles and 206 looms, and used 1,027 bales of cotton weighing 555,578 pounds to produce 310,192 pounds of filling and 168,102 pounds of warp. The Dye House dyed 147,182 pounds of filling and 251,368 pounds of yarn. The Glencoe looms produced 541,034 cuts, totaling 444,937 pounds of cloth 2,666,617 yards in length.

In 1924 the 134 employees worked 10 hours per day, 55 hours per week. For the 93 male employeees the highest average daily wage was $6.60 and the lowest was $2.10. For the 39 female employees the highest average daily wage was $2.38 and the lowest was $2.10. Only two children were employed in the mill in 1924. In 1927 the mill closed for July 4, Thanksgiving, Easter, and a week at Christmas. Production cut-backs shut down the mill for a week; snow closed the mill for one day; 5 hours were taken off in connection with a circus show; and wheel repair shut down the mill for 2.5 hours. As was reported in 1905, approximately 500 people were directly dependent upon Glencoe in 1924.

Electric Power:

In 1894 Glencoe installed electric lighting in the Mill Building, using an 18" Victor turbine to drive the small dynamo. In 1903 a small steam powered dynamo purchased fro the new Finisher and Napper Room provided additional electricity for lighting. In 1904 the Glencoe management apparently considered installing water powered generators to generate electricity for powering machinery. Glencoe asked the General Electric Company for a proposal, specifications, and a cost estimate for installing a generator with sufficient capacity to light the plant and drive the machinery in the Picker House and the Finishing and Napper Room. The $3,833.00 estimate included a 75 KW 600 volt revolving field generator; two transformers; a 50 hp motor for the Napper Room and a 20 hp motor for the Picker House; and the necessary switchboard and wiring equipment.

The General Electric salesman urged Glencoe to expand their interest in electrification, "I believe you will find it well worth the cost to change over the entire plant to the electrical drive." The $7,454.00 estimate for total conversion included a 250 KW 600 volt revolving field generator; two transformers; a 50 hp motor for the looms on the first floor; a 100 hp motor for the second floor spinning machinery; a 50 hp motor for the Finishing and Napper Room and Dye House; a 20 hp motor for the Picker House; and the necessary switchboard and wiring equipment.

The motors would be mounted on the ceiling and would drive the same shafting that the water wheel and steam engine drove. The proposed machinery would equal the horsepower already present in the plant, but the installation would have enabled future expansion of the plant well beyond the limits imposed by available water power. The Glencoe management, with Robert L. Holt as company president, apparently did not consider electrical drive "well worth the cost" and neither of the General Electric proposals were accepted. [53] If Glencoe had purchased the General Electric equipment it would have pioneered the use of electric powered machinery in Alamance County's cotton mills. For this reason the new power transmission technology was in all likelihood treated rather cautiously.

Around 1910 Robert L. Holt initiated the development of the Latonia Power Plant, a dam and hydro-electric generating facility 1.5 miles up the Haw River from Glencoe. The plant cost over $50,000.00 and was primarily intended to change the Lakeside cotton mill from steam and water power to electric drive. The small plant operated one turbine. It appears that while Glencoe continued to rely primarily on water and steam power it did draw some power from the hydro-electric development at Latonia. In 1912 Holt wrote General Electric, "I beg to confirm order given Mr. Latta for the services of an expert for erecting generator and equipment at my Power Station, and motors for the Lakeside and Glencoe Mills. It is my understanding that we are to pay for the services at $7.00 per day and expenses." [54]

Glencoe's lack of growth between 1905 and 1930 obviated substantial increases in power. It is likely that power from Latonia, as well as electrical power generated from a steam powered generator in the Glencoe Dye House, provided light and ran motors in the Dye House, Finishing and Napper Room, and the Picker House during the 1910s and 1920s. When Lakeside Mill drew its electrical power from the Latonia Power Plant it stopped using steam and water power at the mill. Lakeside and Glencoe thus became the first cotton mills in Alamance County to draw electrical power from a generating plant outside the mill. [55]

In the late 1930s all of the shafting and textile machine lines at Glencoe were converted to electric drive as General Electric had proposed in 1904. Even with the adoption of electric drive the advantages of Glencoe's

water power and the reason for originally locating on the Haw River were not neglected. Instead of abandoning the available water power after electric drive was adopted, the 48" Cylinder Gate Victor Turbine driving the Mill's line shafts now generated electricity to power and electric motors driving the line shafts. The turbine's horizontal shaft was cut off where it ran into the Mill Building and the 107" diameter pulley with a 26" face was moved from just inside the Mill Building wall to just outside in the Generating Room. The pulley was belted onto the pulley of a General Electric 2,300 volt Alternating Current Generator. A 125 volt General Electric Direct Current Generator helped set up the magnetic field needed to generate electricity in the Alternating Current Generator.

The generators which are still in place (1977) in the Generator Room (Wheel House) played a significant part in the earliest application of electric drive to a cotton mill in Alamance County. The Glencoe generator was purchased from the Virginia Cotton Mills in Swepsonville, Virginia. The generator was installed at Swepsonville in 1905-1906 as part of a steam-electric power plant to produce power for the first electric motor driven cotton mill machinery in the county. Glencoe continued to draw electric power from Latonia Power Plant, and in July, 1939, purchased its first electric power, 175 KW and 575 volts, from the Duke Power Company. The adoption of electric power led to the removal of the old lighting hydnamos and the 18" Victor turbine. [56]

The 48" Victor turbine and the Lombard Governor remaining at Glencoe help to outline the early history and importance of water powered cotton mills and villages in Alamance County. The General Electric Company Alternating Current Generator, driven by steam at Swepsonville, by water at Glencoe, and supplementing outside electric energy point to the transitions of power drive technology in the cotton mill from water to steam and finally to electricity. This technical transition, the automobile, and other technical developments eliminated the cotton mill village as a necessary place to work and live.

A parallel exists between Glencoe's changes in power technology and its business history up to 1954 when it ceased operation. When Glencoe converted to electric drive in the 1930s it continued to draw power from its available water supply and operated with a degree of independence from other sources. Thus the Mill continued to rely on the nineteenth century system of internal hydro power generation. In the nineteenth century Glencoe depended on regional and antional marketing patterns while the mill village represented independence and self-sufficiency. Throughout its history Glencoe remained a small independent cotton mill and isolated village.

In the 1940s and early 1950s the number of spindles increased to 5,760 and the mill continued to operate approximately 200 looms. The mill's cotton

and shirting flannels were sold through its primary New York sales agent, J. W. Valentine Company. In the mid 1940's the plant expanded with a one story basement brick and concrete addition on the front of the mill, and a reinforced concrete dam, replacing the flood-damaged wooden dam, continued to divert water used in dyeing, water sprinkler system, and driving the turbine.

During the 1940s and 1950s growing competition and the rapid consolidation of small cotton mills into large textile corporations disrupted Glencoe's nineteenth century marketing network. The consolidated textile corporations began in-house advertising and marketing which undermined the operations of the small mill's commission sales agents. The more expensive cloth from the small mills sold through agents put them in a percarious financial situation. The economics of scale and ample resources to adopt new technology, such as cloth printing, drove Glencoe out of business in 1954. [57]

Since ending its cotton mill operation Glencoe has housed several small textile manufacturing operations. The Mill Building is now occupied by the Glencoe Carpet Mills as a work and warehouse space and as a retail factory outlet for clothes and carpets. The remodled second floor is used for offices. No old textile machinery remains, but the turbine, governor, generator, and electrical switchboard are in place in the Wheel House. The other buildings are either vacant or used for storage. Idle modern spinning, weaving, and printing machinery is in place. Since the mill closed, much of the housing has been abandoned and the company store has ceased operation. The overall village presents a remarkably well preserved view of an 1880s Southern waterpowered mill village.

Footnotes

1. Alamance County Deed Books, Book 7, Page 348.
2. Alamance County Deed Books, Book 6, Page 21. Take it from text.
3. Alamance County Deed Books, Book 7, Page 348; Julian Hughes, Development of the Textile Industry in Alamance County, Berlington, 1965, p. 29.
4. Andrew Warren Pierpart, "Development of the Textile Industry in Alamance County, North Carolina," Ph.D. dissertation, University of North Carolina, Chapel Hill, Department of Economies, 1953.
5. Pierpart, "Textile Industry in Alamance County," p. 83.
6. Ibid., p. 59.
7. Ibid.
8. Alamance County Deed Books, Book 7, Page 297 and 946.
9. D. A. Tompkins, Cotton Mill Processes and Calerelaties, Charlotte, 1899.
10. George F. Swein, "Report on the Water-Power of the Southern Atlantic Water-Shed," in Department of the Interior Census Office, Reports on the Water-Power of the United States, 1885, p. 727-728.
11. Ibid.
12. State of North Carolina, Bureau of Labor Statistics, 4th Annual Report, 1890, Raleigh, 1890, p. 28.
13. Clencoe Cash Book, Machinery Account: 1880-1882."
14. Robert Poole & Son Co. to C, 12 June 1894, 16 June 1894.
15. S-B, S-V Co. to G, 1 August 1894.
16. Sanborn Insurance Maps, 1913, 1918, 1829 and Associated Factory Mutual Fire Insurance Companies Map, 12 September 1940.
17. Glencoe Cash Book, "Machinery Account: 1880-1882," C. F. Ivey, Loom-Fixing and Weaving, Shelby, 1896, p. 97.
18. G to Lowell Machine Shops, 12 January 1912; Draper Co. to C, 9 April 1900; Glencoe Cash Book, "Machinery Account: 1880-1882."
19. Ibid.

20. Ibid.

21. Ibid., the bill from Etlinger & Edmund was for $821.20.

22. North Carolina, Bureau of Labor Statistics, 4th Annual Report, 1890, Raleigh, The loom, horsepower and spindle figures given for "Alamance County Cotton Mill No. 4" clearly identify the mill as Glencoe, p. 28-29.

23. Elizabeth A. Hyde and L. Magnussan, "Southern Cotton-Mill Villages," in U. S. Department of the Interior, Bureau of Labor Statistics, Bulletin No. 263, Housing By Employers In the United States, Washington, 1920.

24. Ibid., p. 15

25. Robert Poole & Son Co. to C, 12 June 1894, 16 June 1894; Stilwell-Bierce, Smith-Vaile Co. to G, 27 July 1894, 1 August 1894, 4 August 1894, 6 August, 1894.

26. The Lombard Governor Company to G, 18 August 1904, 15 November 1904; G to Lombard Governor Company 13 May 1913, Lombard Governor Company, Lombard Governors for Water Wheels [and] Steam Engines, Catalogue D, Boston, 1903; Daniel W. Mead, Water Power Engineering, New York, 1915, pp. 243-276, 460-502.

27. Stilwell-Bierce, Smith-Vaile Company to G, 1 October 1894.

28. G to Stilwell-Bierce, Smith-Vaile Company, 2 October 1894.

29. Stilwell-Bierce, Smith-Vaile Company to G, 24 September 1894, 5 October 1894.

30. Alamance Cleamer, 20 December 1894.

31. Stilwell-Bierce, Smith-Vaile Company, 5 October 1894.

32. Woonsocket Napping Machinery Company to G, 29 April 1897.

33. Richard C. Borchers & Co. to G, 28 March 1902; 20 December 1904, 23 January 1909.

34. B. S. Ray & Son Co. to C, 13 December 1903; C to Davis & Farker Machine co., 23 May 1912.

35. O. A. Robbins & Co. to C, 18, 24, September 1903, 16, 24, 25, October 1903, 25 November 1903, 2 January 1904.

36. G to Nagle Engine & Boiler Works, 2 February 1902, 15 March 1902; General Electric Company to G, 9 September 1903.

37. Brownell Company to G, 30 November 1903.

38. Luwig & Co. to G, 19 December 1925.

39. Hoover, Owens, Rentschler Co. to G., 9 August 1906, 31 October 1906.

40. G to Tolhurst Machine Works, 9 April 1914; G to Grensbro Supply Company, 29 May 1918.

41. G to H. W. Buttsworth Co., 16 December 1912.

42. Klauder-Weldon Dyeing Machine Co., to G, 26 June 1897; Glencoe to K-W DM Co., 8 February 1908.

43. Whiten Machine Works to G, 2 November 1900, 29 July 1904, 12 May 1905.

44. Howard & Bullough American Machine Company, to G, 1 October 1905, [invoices 2012-2017]

45. Ibid., 11 November 1903.

46. Production Book Glencoe Mills, "Spinning Room 1904-1910."

47. Crampton-Thayer Loom Co. to G, 15 February 1905; Alexander & _____ Co. to G, 18 February 1907.

48. R. C. Biberstein to G, 24 January 1907, 1 July 1907.

49. G to Lowell Machine Shops, 12 April 1906; G to J. G. Hood, 7 March 1907; Howard & Bullough American Machine Co. to G, 21, 27, November 1906.

50. Dausan's Blue Book Textile Directory, 1888-1940.

51. Census of Manufactures, 1905, this completed survey form is on the Records of the Glencoe Mills.

52. Ibid., State of North Carolina, Bureau of Labor Statistics, 19th Annual Report, 1905, Raleigh, 1905.

53. General Electric Company to G, 24 August 1904, 12 September 1904.

54. G to General Electric Company, 29 October 1912, the State of North Carolina Bureau of Labor Statistics, 27th Annual Report, 1913, notes the change to electric power at both Lakeside and Glencoe; Pierpart,"Textile Industry in Alamance County," p. 91.

55. Pierpart "Textile Industry in Alamance County," p. 91.

56. Hughes

57. Interview with Mr. Walter G. Green, 8 July 1977.